Transfigured Electron Double Slit Experiment

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(The 7 is Silent)

Motivation

- Mobility Measurements made in Superfluid Helium at ~ 1 degree Kelvin

- Electrons injected into the superfluid where a helium bubble forms around the electron consisting of several helium atoms

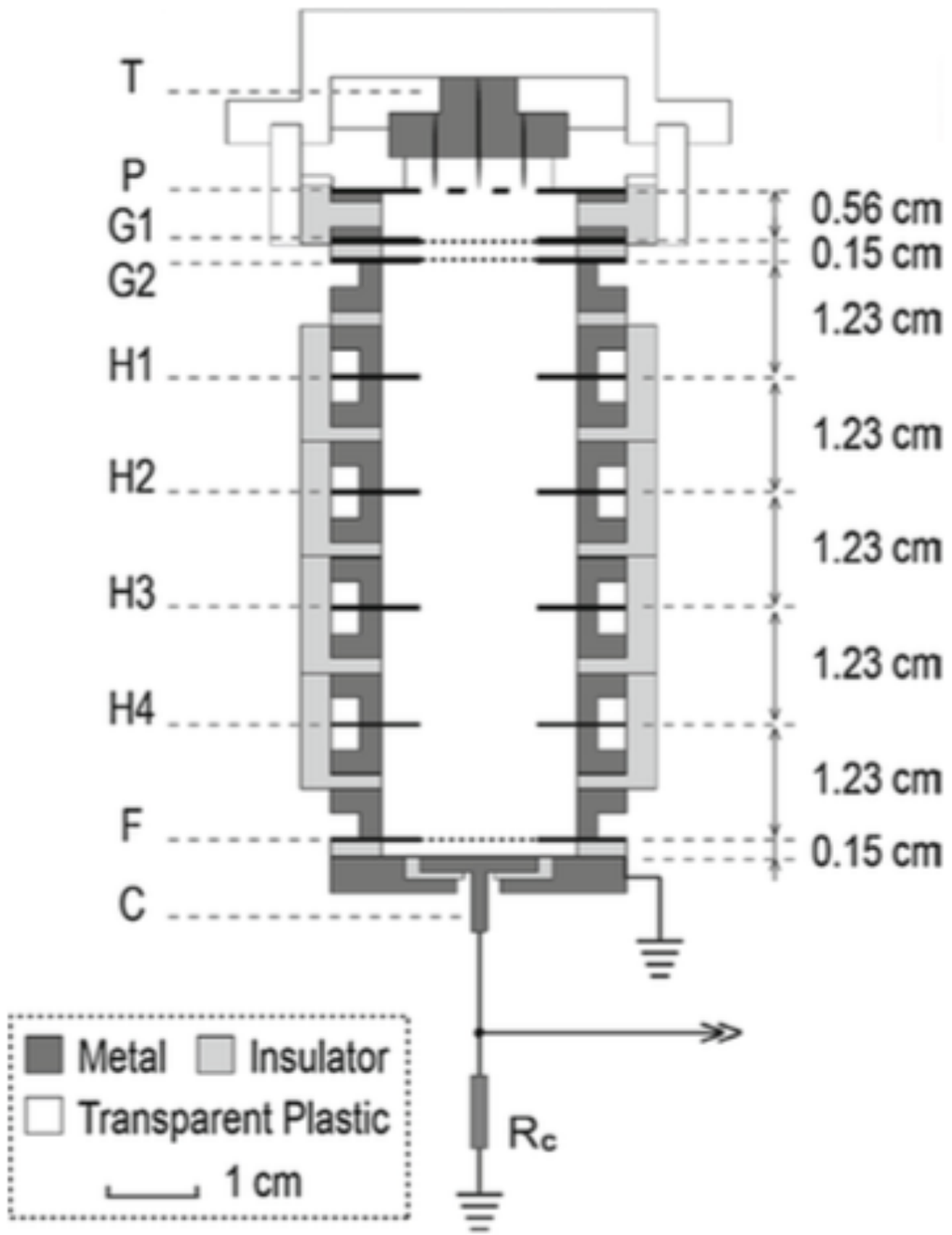
- Mobility is measured by drifting the bubbles in an electric field and measuring the drift time to the anode

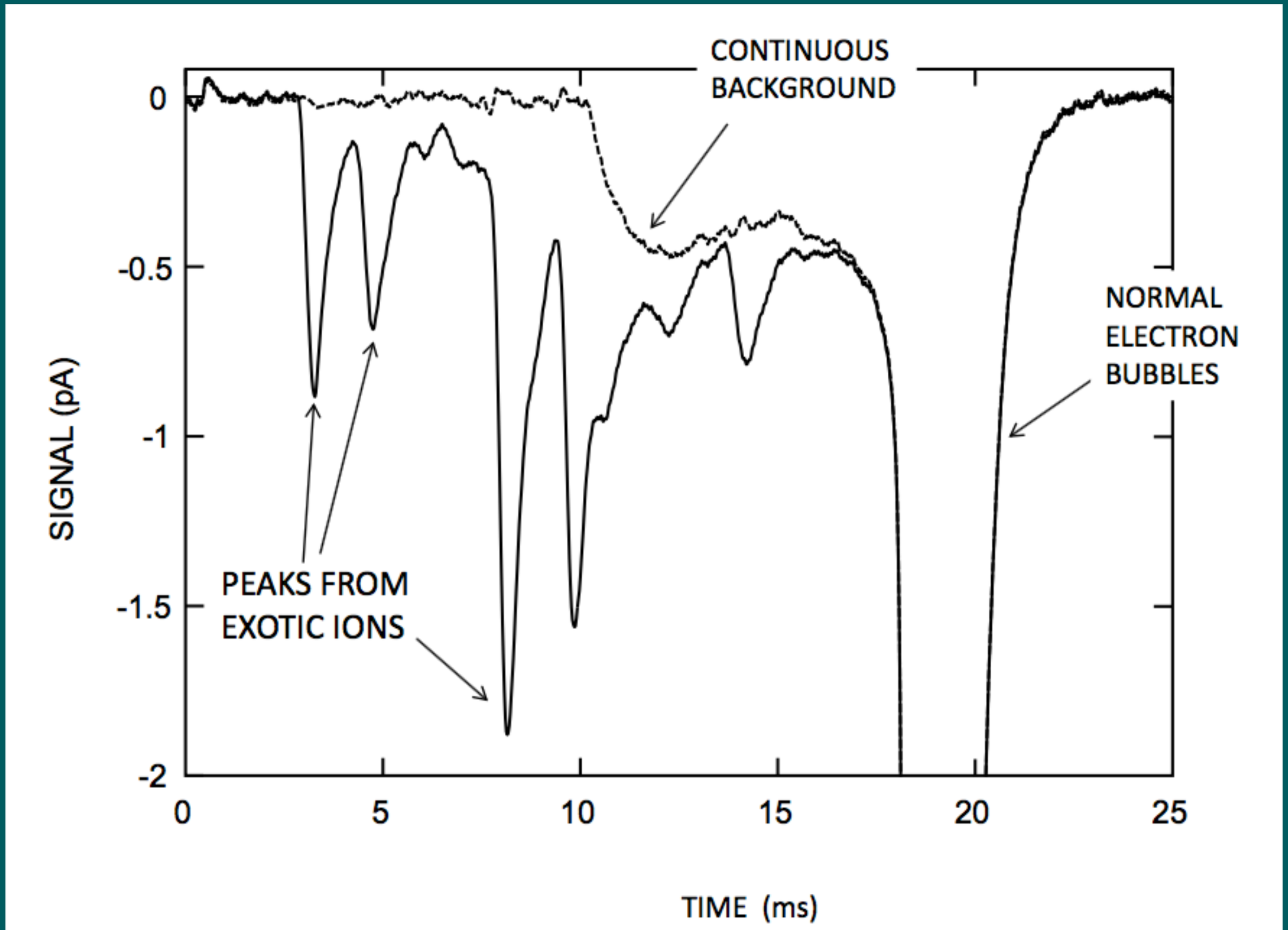
- First experiment done in 1969 — many subsequent experiments with refinements

Ref. J Low Temp Phys (2015) 178:78-117 (+ 55 additional Ref.)

Apparatus to Measure Electron Bubble Mobility

Fig. 2 Cross-section through the experimental cell showing the tungsten tips T, the perforated plate P, gate grids G1 and G2, field homogenizer disks H1–H4, Frisch grid F and ion collector C




CONTINUOUS
BACKGROUND
NORMAL
ELECTRON
BUBBLES
PEAKS FROM
EXOTIC IONS
SIGNAL (pA)
0
-0.5
-1
-1.5
-2
0
5
10
15
20
25
TIME (ms)

Electron Bubbles

(Quantum Objects)

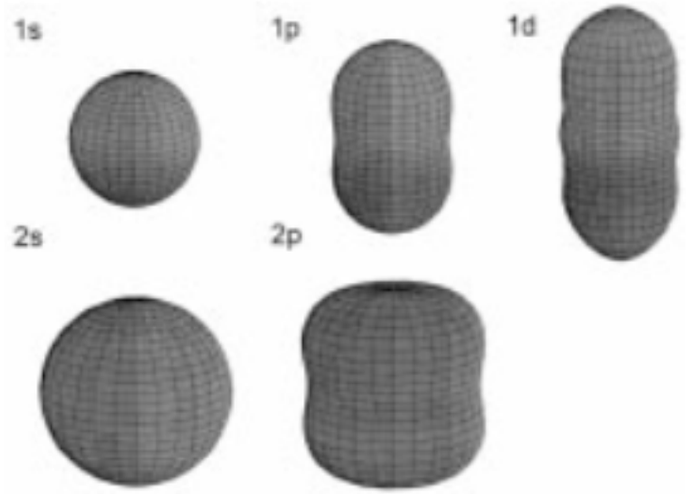


Fig. 4. The shape of bubbles containing electrons in different quantum states. The liquid pressure is zero. The same scale is used for each state, and the radius of the 1s bubble is 19.4 Å.

Possible States

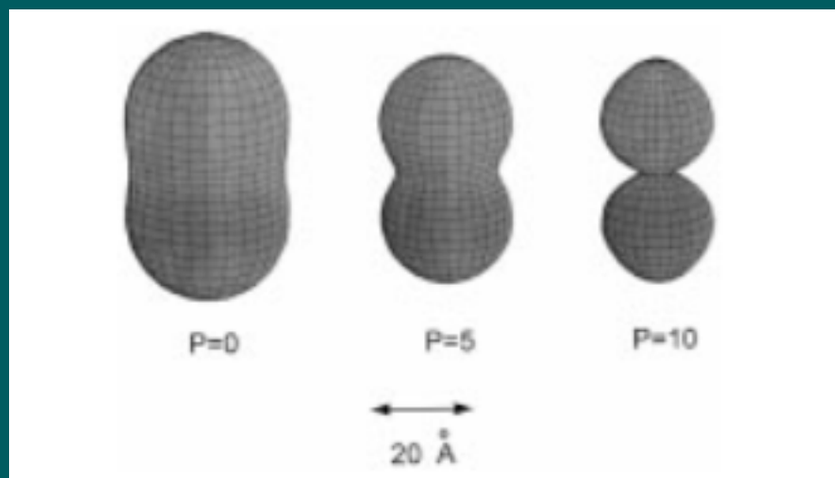
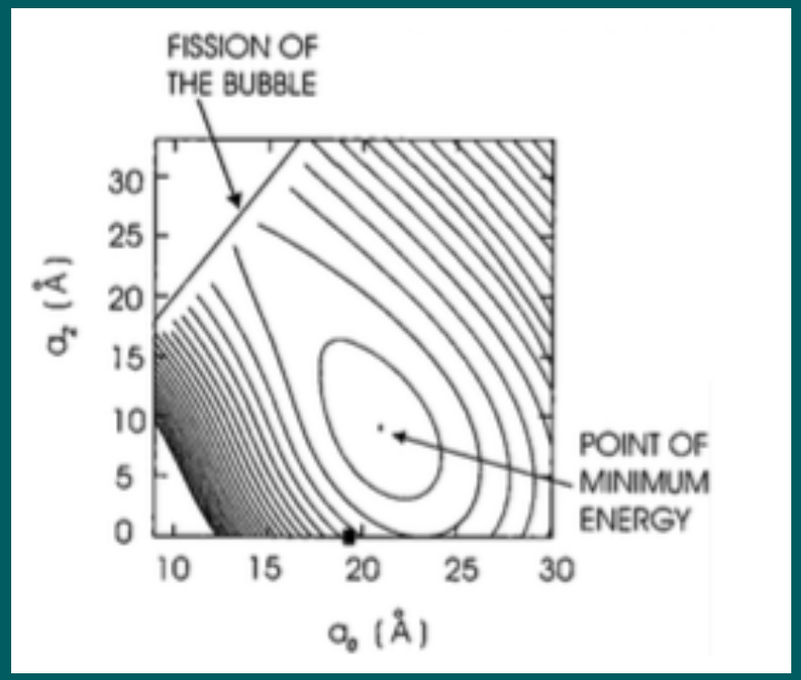
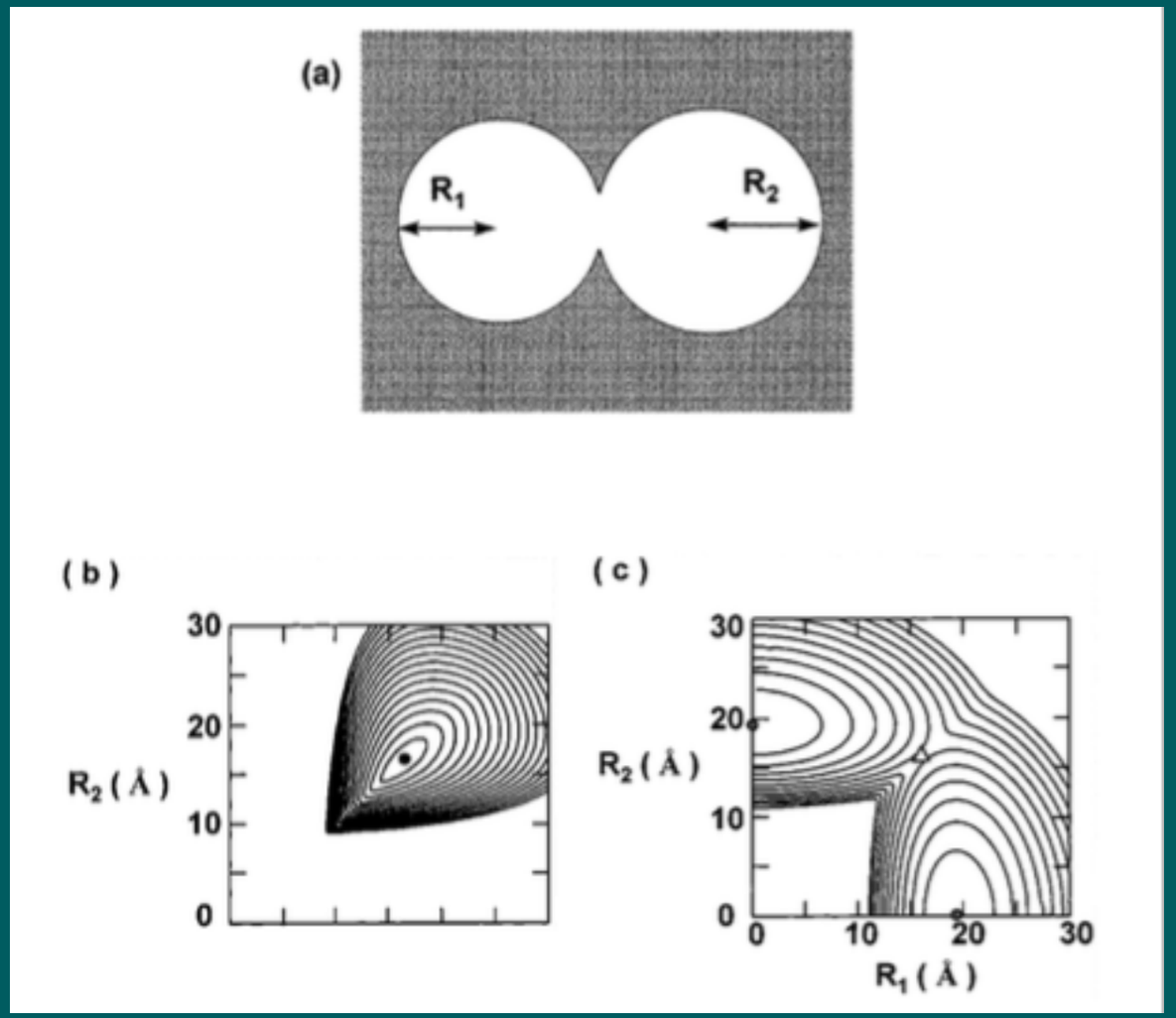


Fig. 5. The shape of the electron bubble containing a 1p state at pressures of 0, 10, and 20 bars.

Effect of Pressure on Electron Bubble States

Fission of Electron Bubbles



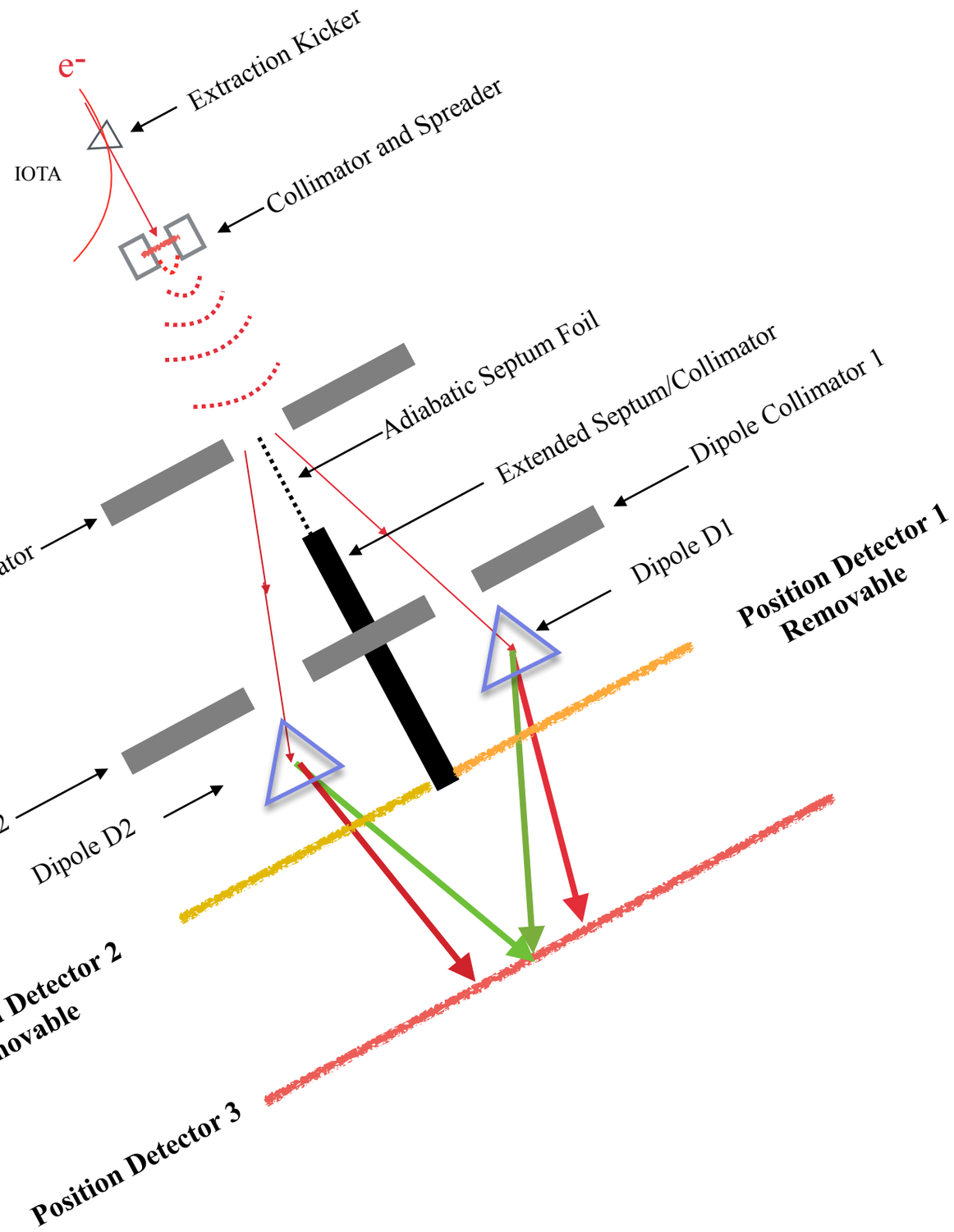


Electron appears to be simultaneously trapped in two separate bubbles ⇒ fractional electron hypthesis: Electrinos

Summary of Results and Explanations

- **Experiment has been done many times in superfluid Helium with consistent results**
- **As experiments were refined more "Exotic Ions" (Fast Ions) became visible**
- **Only explanation put forward was that electrons were split between more than one bubble; such electrons were individually dubbed electrinos**
- **Photoconductivity experiments give consistent results; i.e., light at the proper frequency increases photoconductivity ⇒ increasing mobility of bubbles**
- **Mobility result is firmly established; interpretation is in question**
- **Many think superfluid helium is too complicated to understand; this does not apply to those working with it as evidenced by the large number of quantum calculations and correct predictions in the literature**
  - **Result has no completely independent confirmation that might aide the interpretation**
  - **Objections are of the nature "It can't happen because that is not the way quantum mechanics works"**
  - **Conclusion: It is time to do an experiment that does not depend on Superfluid Helium**

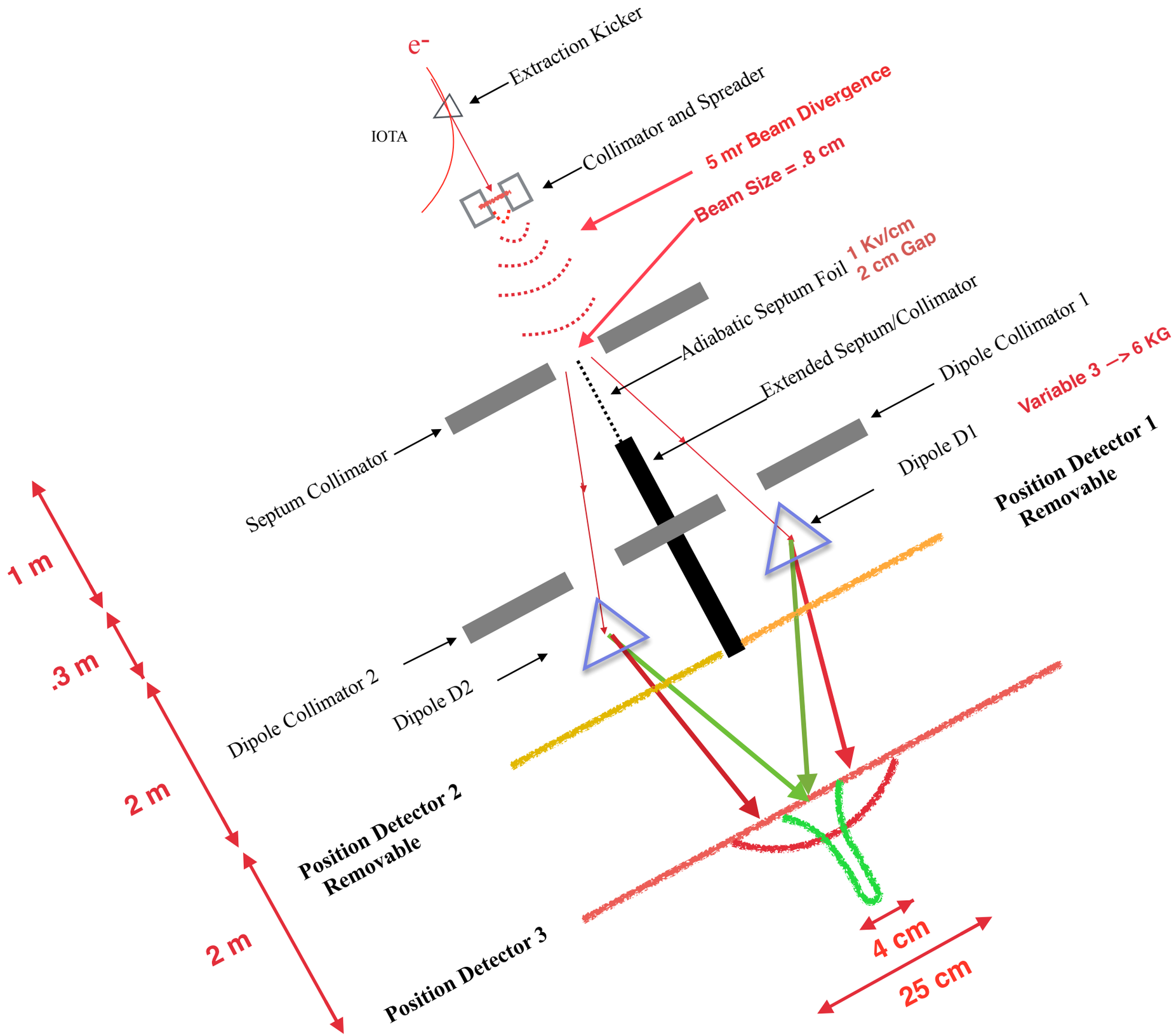
A conceptual Proposal



Experiment

- **Begin with one electron, or a small number of electrons in IOTA**
- **Close collimators to one side of the experiment and then the other**
- **Record electron hits in position detector**
- **Repeat for other side of apparatus**
- **Open both sides**
- **Look for evidence that the electron is on both sides at once ⇒ less bending — Peak will broaden**
- **Scan one magnet at a time to increase signal**

Sample Arrangement



"My own conclusion is that today there is no interpretation of quantum mechanics that does not have serious flaws. This view is not universally shared. Indeed many physicists are satisfied with their own interpretation of quantum mechanics. But different physicists are satisfied with different interpretations. In my view we ought to take seriously the possibility of finding a more satisfactory theory, to which quantum mechanics is only a good approximation."

Steven Weinberg

Lectures on Quantum Mechanics

Chapter 3, p.102

2015

Acknowledgements

- **Sergei Nagaitsev for suggesting that a quantum experiment might be interesting in IOTA and making a number of suggestions for a topic**
- **Patrick Fox, FNAL Theoretical Physics, for useful discussions and for reviewing my concept for a measurement and pronouncing it fit (even if he doesn't believe in electrinos)**
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- **Dan, Howie, and Chris for putting up with electrinos at the lunch table**